CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD April 13, 2011

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM THE PORT OF EVERETT MARINA, EVERETT, SNOHOMISH COUNTY, FOR UNCONFINED OPEN-WATER DISPOSAL AT THE PORT GARDNER DMMP SITE.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the suitability of 131,700 cubic yards (cy) of dredged material from the Port of Everett Marina for disposal at the Port Gardner DMMP open-water site.

2. Background. The Everett Marina is located in Everett, adjacent to the Snohomish River (see Figure 1). Previous rounds of sediment characterization were conducted in 1988, 2000 and 2004. A single dredged material management unit (DMMU) failed bioassays in 1988 and was found unsuitable for open-water disposal. All other material has been found suitable for open-water disposal since that time. Dioxin testing was not conducted during any of the three previous sediment characterization events.

   The site of the former Everett Shipyard, in the northeast corner of the marina (see Figure 2), has been identified as a Puget Sound Initiative (PSI) cleanup site. The Washington State Department of Ecology, ESY Inc. and the Port of Everett entered into an Agreed Order (No. DE 5271) in April 2008 to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the site (AMEC, 2010). This DMMP suitability determination addresses sediment adjacent to, but outside, the boundaries of the cleanup site.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	Low-moderate (modified)
Dredging volume	131,700 cubic yards
Proposed dredging depth	North Basin (DMMUs 1 to 7): -12 feet MLLW plus 2 feet overdepth South Basin (DMMU 8): -12 feet MLLW plus 1 foot overdepth
1st draft sampling and analysis plan (SAP) received	May 13, 2010
DMMP comments provided on 1st draft	June 7, 2010
2nd draft SAP received	June 23, 2010

DMMP comments provided on 2nd draft	July 9, 2010
Final revisions to SAP received	July 13, 2010
SAP revisions approved	July 15, 2010
Sampling dates	August 16-20, 2010
Data report received	April 1, 2011
DAIS Tracking number	POEMA-1-A-F-304
USACE Permit Application Number	TBD
Recency Determination (low-moderate rank = 5-7 years)	August 2015 – August 2017

4. Project Ranking and Sampling Requirements. In a low-moderate-ranked area the number of samples and analyses are calculated using the following guidelines (DMMP, 2008a):
   - Maximum volume of sediment represented by each field sample = 8,000 cubic yards
   - Maximum volume of sediment represented by each analysis in the upper four feet of the dredging prism (surface sediment) = 32,000 cubic yards

   For this project, all dredged material was considered surface sediment, with dredging depths in most areas ranging from 1 to 5 feet. Based on the guidelines, the proposed dredging volume of 131,700 cy would require a minimum of 17 field samples and 5 DMMUs. However, because of heightened concern for sediment near the PSI cleanup site, the DMMP agencies required more field samples and smaller dredged material management units (DMMUs) in this area. The approved SAP included 24 field samples and 8 DMMUs (see Figure 2 and Table 2).

5. Sampling. Sampling took place August 16-20, 2010 using a pneumatic impact corer. Table 3 includes the coordinates of the sampling stations and compositing information. Samples were collected in compliance with the approved sampling plan, with the following minor exceptions: a) two stations (MBR-1 and MBR-8) needed to be relocated at the time of sampling because the target locations had insufficient sediment depth; and b) a one-foot z-sample was inadvertently taken at MBR-12, instead of the two-foot z-sample called for in the sampling plan. Neither of these deviations was consequential and the DMMP agencies accepted the samples as representative.

6. Chemical Analysis. The approved SAP was followed and quality control guidelines specified by DMMP were generally met. The sediment conventional and chemistry results can be found in Table 4. The grain-size data show that the proposed dredged material is predominantly sandy silt to silty sand, with a fines fraction ranging from 49 to 95% for the eight DMMUs. The total organic carbon content ranged from 0.7 to 2.4%.

   The preliminary chemistry results indicated that there were no detected exceedances of screening levels (SLs) for the standard DMMP chemicals of concern. However, reporting limits for 2,4-dimethylphenol, benzyl alcohol and N-nitrosodiphenylamine were above their respective SLs for DMMUs 6 and 8. The elevated reporting limits were due to the samples having been diluted for the initial analysis. These samples were rerun – without dilution – and analyzed for the three chemicals in question. Reporting limits for the undiluted samples were all below SL. Table 4 includes data from the reanalysis only.

The only other quality control problem occurred for antimony, for which the matrix spike recovery was below the laboratory control limit. The data validator, Sayler Data Solutions, rejected the antimony data for use. The low recovery indicates that the reported values might be biased low; however, antimony was undetected in the samples at a reporting limit of 7 to 8 parts per million (ppm), well below the SL of 150 ppm. Chemical results in other historic samples collected in the area have not found antimony to be a contaminant of concern (AMEC, 2011). Therefore, the DMMP agencies agreed that antimony was unlikely to pose an environmental risk for this project.

The DMMP agencies required that tributyltin (TBT) be analyzed in porewater samples from the DMMUs adjacent to the PSI cleanup area (DMMUs 4, 6 and 7). The TBT results for these three samples were all below the SL of 0.15 ug/l.

Dioxins were analyzed in two rounds of testing. The DMMP agencies initially required dioxin testing in the three DMMUs adjacent to the PSI cleanup area (DMMUs 4, 6 and 7). Composited samples representing these DMMUs were tested by Analytical Resources Incorporated using EPA method 1613B. Results from this first round of testing revealed elevated dioxin concentrations, ranging from 6.6 to19.4 ng/kg. The elevated concentrations near the PSI site prompted the DMMP agencies to require a second round of testing, including composited samples from each of the remaining DMMUs, as well as some composited and some uncomposited z-samples from select locations. The second round of testing was conducted on archived sediment by Axys Analytical using EPA method 1613B. Concentrations from this round of testing ranged from 3.9 to 11.4 ng/kg for DMMUs 1, 2, 3, 5 and 8 and from 0.2 to 17.2 ng/kg for the z-samples. Dioxin results from both rounds of testing are provided in Table 5 and Figure 2. Stage-4 validation of the dioxin data from both rounds of testing was performed by EcoChem, Inc.

7. Decision by the Port of Everett to Pursue Dredging of DMMU 1 only. Due to complications posed by the dioxin data for the Port of Everett's original dredging plan, and the need to complete at least some dredging in the next dredging year (June 16, 2011 to June 15, 2012), the Port decided to pursue dredging of DMMU 1 immediately and asked the DMMP agencies to hold in abeyance any decision regarding the remainder of the project with respect to dioxin. A redesign or additional dioxin analysis may be needed to pursue dredging beyond DMMU 1. The DMMP agencies agreed to this plan. Therefore, the remainder of this document addresses the suitability of all DMMUs with respect to the standard chemicals of concern (plus TBT), but addresses the suitability with respect to dioxin of DMMU 1 only. A decision about the remaining material with respect to dioxin will be documented in a future supplement to this suitability determination.

8. Sediment Exposed by Dredging. Sediment exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) (Ecology, 1995) or the State's antidegradation standard (DMMP, 2008b). For this project, dioxin was the main concern since all other chemicals were below the DMMP SLs. The DMMP agencies did not require dioxin analysis of the z-samples for DMMU 1 during the second round of testing, but other circumstantial evidence appears to indicate that sediment that would be exposed by dredging of DMMU 1 should meet the antidegradation standard: a) DMMU 1 is farther away from the PSI cleanup area than any other DMMU and dioxin concentrations tend to trend downward away from the PSI site; b) DMMU 1 had the lowest dioxin concentration of all the DMMUs; c) DMMU 1 had the lowest fines content of any DMMU; and d) with the exception of DMMU 6, which is immediately adjacent to the PSI area, the

dioxin concentrations in all z-samples were less than the concentrations in overlying material. The DMMP agencies agreed that the probability of finding elevated concentrations of dioxin in material underlying DMMU 1 is low and that DMMU 1 can be removed without violating the State's antidegradation standard.

9. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from the Port of Everett Marina for open-water disposal. The approved sampling and analysis plan was followed and the data gathered were deemed sufficient (with the exception of dioxin for dredged material other than DMMU 1) and acceptable for regulatory decision-making under the DMMP program.

   There were no SL exceedances for standard DMMP chemicals of concern or TBT. Therefore, with respect to these chemicals, all eight DMMUs are suitable for open-water disposal.

   With regard to dioxin, the DMMP agencies established new interim disposal guidelines in December 2010 (DMMP, 2010). The new interim guideline is as follows for non-dispersive sites:

   > *DMMUs with dioxin concentrations below 10 pptr TEQ will be allowed for open-water disposal as long as the volume-weighted average concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 pptr TEQ.*

   DMMU 1 had a dioxin concentration of 3.8 pptr TEQ, meeting both the upper limit of 10 pptr and the volume-weighted average of 4 pptr. Therefore, DMMU 1 is suitable for open-water disposal at the Port Gardner disposal site.

   In summary, based on the results of the previously described testing, the DMMP agencies concluded that the 29,000 cubic yards from DMMU 1 are suitable for open-water disposal at the Port Gardner non-dispersive site. A decision on the 102,700 cubic yards in DMMUs 2 through 8 will be held in abeyance until further work can be completed on the dioxin characterization of this sediment.

   This suitability determination does ***not*** constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

   A pre-dredge meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to dredging. A dredging quality control plan must be developed and submitted to the Regulatory Branch of the Seattle District Corps of Engineers at least 7 days prior to the pre-dredge meeting. A DNR site use authorization must also be acquired. Disposal at the Port Gardner site must be by bottom-dump barge.

10. References.

AMEC, 2010. *Sampling and Analysis Plan – DMMP Full Characterization for Maintenance Dredging at the Port of Everett Marina, Everett, Washington.* Prepared by AMEC Geomatrix for the Port of Everett, July 2010.

AMEC, 2011. *Data Report – DMMP Full Characterization for Maintenance Dredging at the Port of Everett Marina, Everett, Washington.* Prepared by AMEC Geomatrix for the Port of Everett, March 2011.

DMMP, 2008a. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, July 2008.

DMMP, 2008b. *Quality of Post-Dredge Sediment Surfaces (Updated).* A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

DMMP, 2010. *Dredged Material Management Program - New Interim Guidelines for Dioxin.* December 2010.

Ecology, 1995. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, December 1995.

11. **Agency Signatures**.

Concur:

4/19/11 David Fox
Date David Fox - Seattle District Corps of Engineers

4/18/11 Erin Hoffman
Date Erika Hoffman - Environmental Protection Agency

04/15/2011 Laura Inouye
Date Laura Inouye, Ph.D. - Washington Department of Ecology

04-18-2011 David Vagt
Date David Vagt - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Erin Legge – Seattle District Regulatory
Rob Gilmour – AMEC Geomatrix
Graham Anderson – Port of Everett

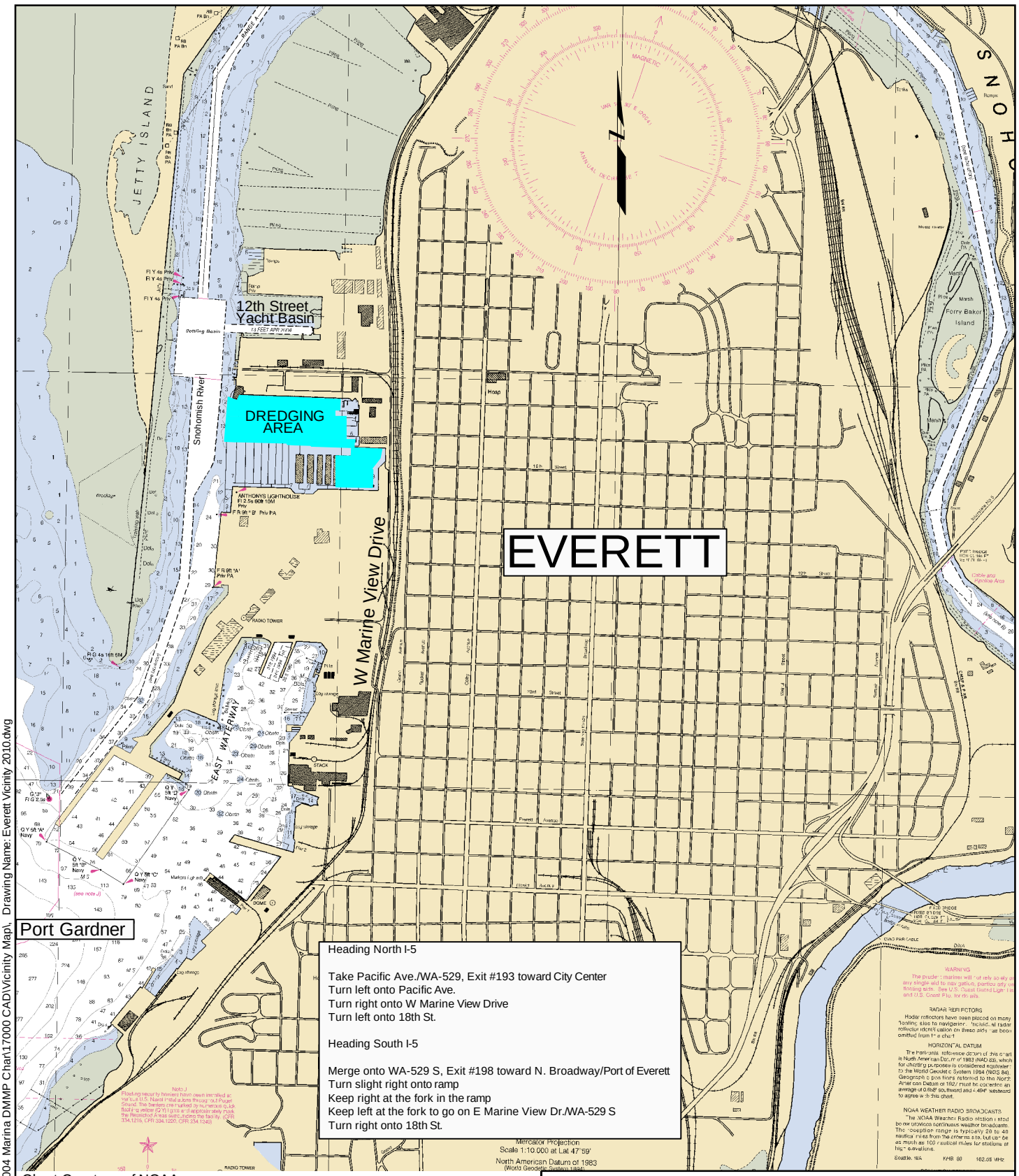


Chart Courtesy of NOAA

47° 59' 50" N
122° 13' 09" W

Section: 18
Township: 29N
Range: 05E

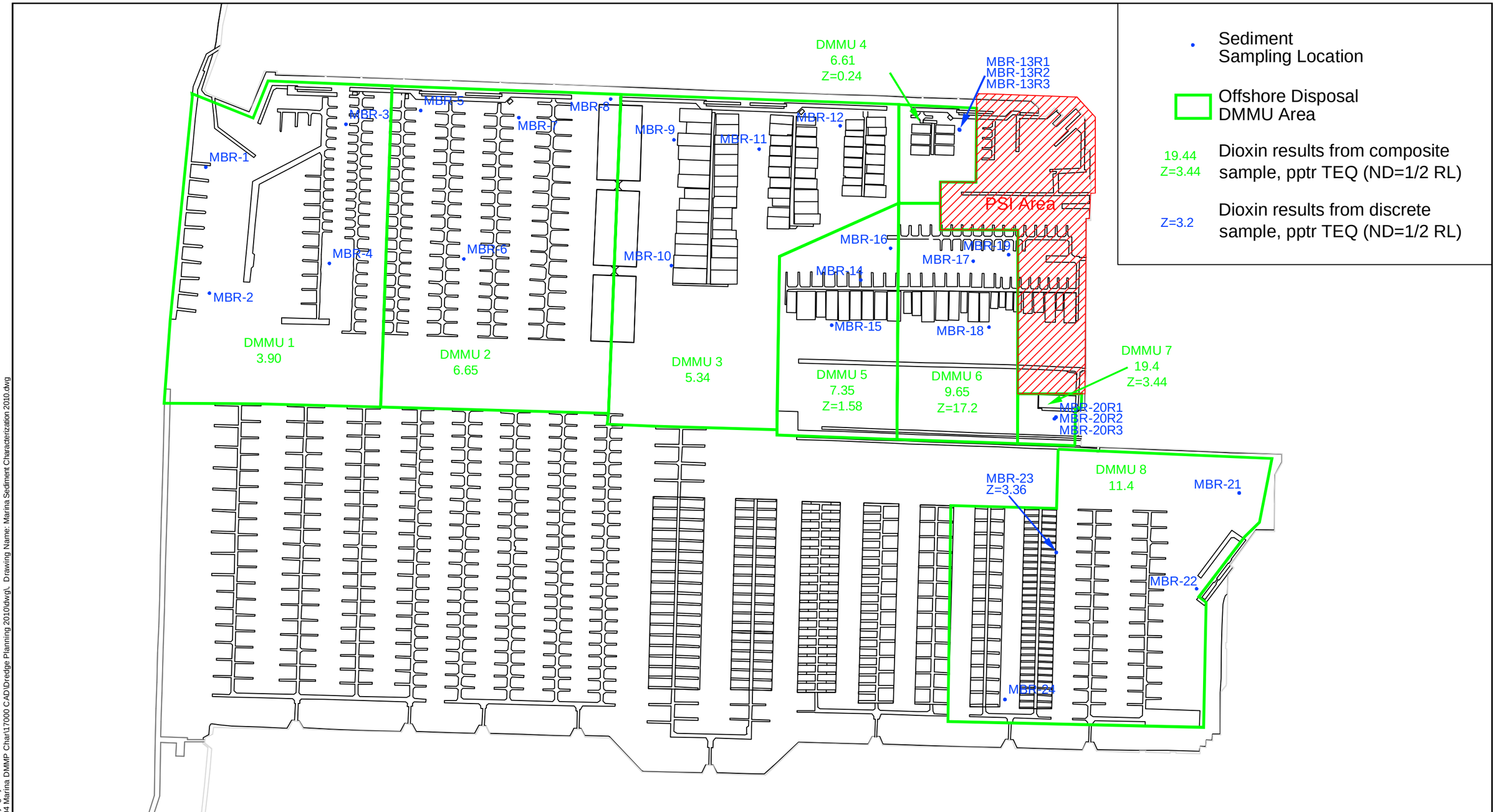
APPROXIMATE SCALE IN FEET

0 1000 2000 4000

PROJECT VICINITY MAP
DMMP Full Characterization for Maintenance Dredging at the Port of Everett Marina
Everett, Washington

By: GSM	Date: 4-29-2010	Project No. 013116004
AMEC Geomatrix		Figure 1

Plot Date: 04/29/10 - 11:31am, Plotted by: gary.maxwell
Drawing Path: P:\PortOfEverett\13116-004 Marina DMMP Char\17000 CAD\Vicinity Map\, Drawing Name: Everett Vicinity 2010.dwg



Notes:
Estimated Dredge Volume = 131,700 cu. yd.
+ 15% Uncertainty Factor = 151,455 cu. yd.
pptr = parts per trillion
TEQ = Toxicity Equivalency Quotient

APPROXIMATE SCALE IN FEET
0 100 200 400
Elevation Datum: 0 ft = MLLW

PLAN VIEW OF DMMU LAYOUT, SAMPLING STATIONS, AND DIOXIN RESULTS
DMMP Full Characterization for Maintenance Dredging at the Port of Everett Marina
Everett, Washington

By: GSM	Date: 3-25-2011	Project No. 013116004
AMEC Geomatrix		Figure 2

Plot Date: 03/25/11 - 11:48am, Plotted by: gary.maxwell
Drawing Path: P:\PortOfEverett\13116-004 Marina DMMP Chart\17000 CAD\Dredge Planning 2010\dwg\, Drawing Name: Marina Sediment Characterization 2010.dwg

TABLE 2 (from AMEC, 2010)

DMMP FULL CHARACTERIZATION REQUIREMENTS
Port of Everett Marina - Everett, Washington

DMMU	Location	DMMU Volume (cubic yards)	Number of Core Locations	Number of Analyses
DMMU 1	North Marina (adjacent to main channel)	29,000	4	1
DMMU 2	North Marina (east of DMMU 1)	28,400	4	1
DMMU 3	North Marina (east of DMMU 2)	28,000	4	1
DMMU 4	North Marina (along north bulkhead and adjacent to PSI area	2,500	1	1
DMMU 5	North Marina (east of DMMU 3)	7,600	3	1
DMMU 6	North Marina (east of DMMU 5 and adjacent to PSI area)	10,500	3	1
DMMU 7	North Marina (along east bulkhead and adjacent to PSI area	1,700	1	1
DMMU 8	South Marina (southeast corner)	24,000	4	1

Total characterized volume: 131,700

TABLE 3 (from AMEC, 2011)

SEDIMENT CORE LOCATIONS AND SAMPLE INTERVALS

DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

Sediment Boring Number	Date	Time	Station Coordinates: State Plane Coordinates NAD 83 WA North Zone, Survey Feet		Station Coordinates: Geographic NAD 83 Degrees-Decimal Minutes		Mudline Elevation (feet MLLW)	Sample Interval Elevation (feet MLLW)	Sample ID	Composite Sample ID	DMMU
			Northing	Easting	Longitude (W)	Latitude (N)					
MBR-1	8/16/10	13:53	367358	1300106	122 13.405270	47 59.920259	-9.1	-9.1 to -14	MBR-1A	MC-1	1
								-14 to -16	MBR-1Z		
MBR-2	8/16/10	10:48	367092	1300113	122 13.402212	47 59.876387	-8.2	-8.2 to -14	MBR-2A	MC-1	
								-14 to -16	MBR-2Z		
MBR-3	8/16/10	11:52	367449	1300402	122 13.332941	47 59.936069	-9.9	-9.9 to -14	MBR-3A	MC-1	
								-14 to -16	MBR-3Z		
MBR-4	8/16/10	12:40	367155	1300367	122 13.340209	47 59.887530	-8.6	-8.6 to -14	MBR-4A	MC-1	
								-14 to -16	MBR-4Z		
MBR-5	8/17/10	8:24	367478	1300561	122 13.294306	47 59.941310	-11	-11 to -14	MBR-5A	MC-2	2
								-14 to -16	MBR-5Z		
MBR-6	8/17/10	9:12	367163	1300651	122 13.270683	47 59.889712	-11	-11 to -14	MBR-6A	MC-2	
								-14 to -16	MBR-6Z		
MBR-7	8/17/10	10:38	367463	1300768	122 13.243333	47 59.939484	-11.2	-11.2 to -14	MBR-7A	MC-2	
								-14 to -16	MBR-7Z		
MBR-8	8/17/10	12:47	367503	1300963	122 13.195890	47 59.946512	-9.7	-9.7 to -14	MBR-8A	MC-2	
								-14 to -16	MBR-8Z		
MBR-9	8/18/10	8:05	367416	1301097	122 13.162667	47 59.932689	-10.9	-10.9 to -14	MBR-9A	MC-3	3
								-14 to -16	MBR-9Z		
MBR-10	8/18/10	8:42	367150	1301091	122 13.162770	47 59.888895	-10.2	-10.2 to -14	MBR-10A	MC-3	
								-14 to -16	MBR-10Z		
MBR-11	8/18/10	9:56	367397	1301277	122 13.118374	47 59.929996	-10.6	-10.6 to -14	MBR-11A	MC-3	
								-14 to -16	MBR-11Z		
MBR-12	8/18/10	10:43	367446	1301449	122 13.076560	47 59.938630	-10.4	-10.4 to -14	MBR-12A	MC-3	
								-14 to -15	MBR-12Z		
MBR-13R1	8/17/10	13:32	367437	1301702	122 13.014491	47 59.937992	-8.8	-8.8 to -14	MBR-13R1A	MC-4	4
								-14 to -16	MBR-13R1Z	DMMU 4Z	
MBR-13R2	8/17/10	13:53	367437	1301702	122 13.014526	47 59.937924	-9	-9 to -14		MC-4	
MBR-13R3	8/17/10	14:23	367438	1301701	122 13.014794	47 59.938125	-8.8	-8.8 to -14		MC-4	

TABLE 3 (from AMEC, 2011)

SEDIMENT CORE LOCATIONS AND SAMPLE INTERVALS
DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

Sediment Boring Number	Date	Time	Station Coordinates: State Plane Coordinates NAD 83 WA North Zone, Survey Feet: Northing	Easting	Geographic NAD 83 Degrees-Decimal Minutes: Longitude (W)	Latitude (N)	Mudline Elevation (feet MLLW)	Sample Interval Elevation (feet MLLW)	Sample ID	Composite Sample ID	DMMU
MBR-14	8/19/10	11:44	367119	1301492	122 13.064412	47 59.885051	-9.6	-9.6 to -14	MBR-14A	MC-5	5
								-14 to -16	MBR-14Z	DMMU 5Z	
MBR-15	8/19/10	12:16	367024	1301431	122 13.079092	47 59.869155	-10	-10 to -14	MBR-15A	MC-5	
								-14 to -16	MBR-15Z	DMMU 5Z	
MBR-16	8/19/10	13:13	367187	1301555	122 13.049292	47 59.896314	-9.8	-9.8 to -14	MBR-16A	MC-5	
								-14 to -16	MBR-16Z	DMMU 5Z	
MBR-17	8/20/10	8:45	367159	1301730	122 13.006246	47 59.892357	-9.7	-9.7 to -14	MBR-17A	MC-6	6
								-14 to -16	MBR-17Z	DMMU 6Z	
MBR-18	8/20/10	10:12	367020	1301764	122 12.997461	47 59.869443	-10	-10 to -14	MBR-18A	MC-6	
								-14 to -16	MBR-18Z	DMMU 6Z	
MBR-19	8/20/10	9:18	367173	1301805	122 12.987976	47 59.894806	-8.9	-8.9 to -14	MBR-19A	MC-6	
								-14 to -16	MBR-19Z	DMMU 6Z	
MBR-20R1	8/18/10	11:51	366829	1301906	122 12.961876	47 59.838517	-9.5	-9.5 to -14	MBR-20A	MC-7	7
								-14 to -16	MBR-20Z	DMMU 7Z	
MBR-20R2	8/18/10	12:10	366829	1301905	122 12.961904	47 59.838568	-9.6	-9.6 to -14		MC-7	
MBR-20R3	8/18/10	12:30	366826	1301902	122 12.962664	47 59.837971	-10.1	-10.1 to -14		MC-7	
MBR-21	8/20/10	10:55	366669	1302294	122 12.866110	47 59.813300	-9.7	-9.7 to -13	MBR-21A	MC-8	8
								-13 to -15	MBR-21Z		
MBR-22	8/20/10	11:23	366466	1302203	122 12.887314	47 59.779678	-7.7	-7.7 to -13	MBR-22A	MC-8	
								-13 to -15	MBR-22Z		
MBR-23	8/20/10	12:43	366543	1301906	122 12.960443	47 59.791448	-9.5	-9.5 to -13	MBR-23A	MC-8	
								-13 to -15	MBR-23Z		
MBR-24	8/20/10	13:15	366231	1301797	122 12.985732	47 59.739930	-9	-9 to -13	MBR-24A	MC-8	
								-13 to -15	MBR-24Z		

Abbreviation(s)
DMMP = Dredged Material Management Program
DMMU = Dredged Material Management Unit
ID = identification
MLLW = mean lower low water
NAD 83 = North American Datum 1983

TABLE 4 (from AMEC, 2011)

DMMP CONVENTIONAL AND CONTAMINANT CHEMISTRY RESULTS[1]

DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

			Sample ID	MC-1			MC-2			MC-3			MC-4			MC-5			MC-6			MC-7			MC-8		
			DMMU	DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 5			DMMU 6			DMMU 7			DMMU 8		
			Sample Type	Composite			Composite			Composite			Composite			Composite			Composite			Composite			Composite		
	DMMP		Date	08/16/2010			08/17/2010			08/18/2010			08/17/2010			08/19/2010			08/20/2010			08/18/2010			08/20/2010		
Parameter	**SL**	**BT**		**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**
Conventionals (%)																											
Total Solids	—	—		62.6			60.8			63.6			63.7			58			55.4			52.5			54.8		
Total Volatile Solids	—	—		6.24			5.86			5.36			4.47			6.54			6.86			7.09			7.02		
Total Organic Carbon	—	—		1.47			1.93			1.31			1.63			1.75			1.95			0.68			2.39		
N-Ammonia (mg-N/kg)	—	—		618			616			265			399			493			931			1680			485		
Sulfide (mg/kg)	—	—		19.9			8.02			12.2			13.5			28			51.3			67.9			29.7		
Grain Size																											
Gravel (phi <-1)	—	—		0.2		J	0.3		J	1.9		J	0.1		J	2.5		J	0.7		J	0.1	U	UJ	0.2		J
Very Coarse Sand (phi -1 to 0)	—	—		1			1			1.2			0.7			1			1.3			0.9			1.7		
Coarse Sand (phi 0 to 1)	—	—		1.2			1			1.7			1.1			1			1.1			0.7			3.7		
Medium Sand (phi 1 to 2)	—	—		1.9			1.5			6.7			9.1			0.8			0.9			0.4			7		
Fine Sand (phi 2 to 3)	—	—		15.5			5.5			9.8			14.2			1.9			1.8			0.4			5		
Very Fine Sand (phi 3 to 4)	—	—		31			24.5			16.8			12.1			8.6			7.2			2.5			4.5		
Coarse Silt (phi 4 to 5)	—	—		18.7			24			20			17.1			16.7			16.6			14.3			12.2		
Medium Silt (phi 5 to 6)	—	—		10.2			14.4			14.3			16.5			22.4			21.5			26.6			19.2		
Fine Silt (phi 6 to 7)	—	—		5.9			8.3			8.9			10.6			15.5			16.5			21.1			18.1		
Very Fine Silt (phi 7 to 8)	—	—		3			4.7			4.8			5.1			8			8.7			11			9.2		
Clay (phi 8 to 9)	—	—		3.2			3.6			3.4			3.6			5.3			6.5			6.2			5.1		
Clay (phi 9 to 10)	—	—		2.4			3			3.2			2.9			4.4			4.9			5			4.8		
Clay (phi >10)	—	—		5.9		J	8.1		J	7.4		J	7		J	12.1		J	12.4		J	10.9		J	9.3		J
Total Fines (<63 µm)	—	—		49.3			66.1			62			62.7			84.2			87			95.1			77.9		
Metals (mg/kg dry wt)																											
Antimony	150	—		7	U	R	8	U	R	7	U	R	7	U	R	8	U	R	8	U	R	9	U	R	8	U	R
Arsenic	57	507.1		10			10			10			9			11			12			12			12		
Cadmium	5.1	11.3		0.6			0.7			0.7			0.6			0.9			1			1.1			0.9		
Chromium	—	267		47.2			53.4			49.3			46.8			59.6			65.4			64.4			79.8		
Copper	390	1,027		54.5			56.7			49.4			50.1			63.4			71.9			77			67		
Lead	450	—		10			11			10			12			14			16			19			15		
Mercury	0.41	1.5		0.07			0.09			0.08			0.11			0.18			0.14			0.14			0.12		
Nickel	140	370		42			47			45			43			52			56			54			63		
Selenium	—	3		0.7	U		0.8	U		0.7	U		0.8	U		0.8	U		0.8	U		0.9	U		0.9	U	
Silver	6.1	6.1		0.4	U		0.5	U		0.4	U		0.4	U		0.5	U		0.5	U		0.5	U		0.5	U	
Zinc	410	2,783		78			91			73			78			91			98			114			98		
Organometallic Compounds (µg/L)																											
Tributyltin (interstitial water)	0.15	0.15											0.033						0.016			0.047					

TABLE 4 (from AMEC, 2011)

DMMP CONVENTIONAL AND CONTAMINANT CHEMISTRY RESULTS[1]

DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

			Sample ID	MC-1			MC-2			MC-3			MC-4			MC-5			MC-6			MC-7			MC-8		
			DMMU	DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 5			DMMU 6			DMMU 7			DMMU 8		
			Sample Type	Composite			Composite			Composite			Composite			Composite			Composite			Composite			Composite		
	DMMP		Date	08/16/2010			08/17/2010			08/18/2010			08/17/2010			08/19/2010			08/20/2010			08/18/2010			08/20/2010		
Parameter	**SL**	**BT**		**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**
Organics (µg/kg dry wt)																											
LPAH																											
Naphthalene	2100	—		20	U		19	U		16	J		14	J		27			60	U		26			59	U	
Acenaphthylene	560	—		20	U		19	U		20	U		20	U		12	J		60	U		17	J		59	U	
Acenaphthene	500	—		20	U		19	U		20	U		12	J		20	U		60	U		13	J		59	U	
Fluorene	540	—		20	U		19	U		11	J		13	J		12	J		60	U		20			59	U	
Phenanthrene	1500	—		48			28			49			57			54			55	J		81			85		
Anthracene	960	—		22			11	J		23			16	J		28			30	J		37			52	J	
2-Methylnaphthalene	670	—		20	U		19	U		20	U		20	U		20	U		60	U		12	J		59	U	
Total LPAH	5,200	—		70			39	J		99	J		112	J		133	J		85	J		194	J		137	J	
HPAH																											
Fluoranthene	1,700	4,600		74	B	U	91	B	J	200			100	B	J	120			140			240			220		
Pyrene	2,600	11,980		92	B	J	100	B	J	290			120	B	J	250			150			330			260		
Benzo(a)anthracene	1,300	—		62			34			81			38			75			68			97			92		
Chrysene	1,400	—		140			75			120			74			110			140			160			190		
Benzofluoranthenes	3,200	—		110			98			240			76			156			128			240			194		
Benzo(a)pyrene	1,600	—		44			30			57			26			63			51	J		81			78		
Indeno(1,2,3-cd)pyrene	600	—		19	J		16	J		25			14	J		20			60	U		27			34	J	
Dibenz(a,h)anthracene	230	—		20	U		19	U		10	J		20	U		20	U		60	U		12	J		59	U	
Benzo(g,h,i)perylene	670	—		17	J		16	J		25			15	J		18	J		60	U	J/UJ	27			36	J	J/UJ
Total HPAH	12,000	—		558	J		460	J		1048	J		463	J		812	J		677	J		1214	J		1104	J	
Chlorinated Hydrocarbons																											
1,3-Dichlorobenzene [2]	170	—		1.2	U		1.2	U		1.2	U		1.2	U	UJ	1.3	U		1.4	U		1.5	U		1.4	U	
1,4-Dichlorobenzene [2]	110	—		1.2	U		1.2	U		1.2	U		1.2	U		1.3	U		1.4	U		1.5	U		1.4	U	
1,2-Dichlorobenzene [2]	35	—		1.2	U		1.2	U		1.2	U		1.2	U		1.3	U		1.4	U		1.5	U		1.4	U	
1,2,4-Trichlorobenzene [2]	31	—		6	U		6.1	U		6.2	U		5.8	U		6.5	U		6.8	U		7.3	U		7	U	
Hexachlorobenzene	22	168		0.98	U		0.96	U		0.97	U		1	U		0.98	U		0.99	U		0.98	U		0.98	U	
Phthalates																											
Dimethylphthalate	71	—		20	U		19	U		20	U		20	U		20	U		60	U		11	J		59	U	
Diethylphthalate	200	—		20	U		19	U		12	J		20	U		20	U		60	U		20	U		59	U	
Di-n-Butylphthalate	1,400	—		20	U		19	U		30			20	U		28			60	U		42			59	U	
Butylbenzylphthalate	63	—		20	U		19	U		20	U		20	U		20	U		60	U		20	U		59	U	
bis(2-Ethylhexyl)phthalate	1,300	—		32	B	U	53	B	U	53			880	B		37			60	U		120			88	B	U
Di-n-Octyl phthalate	6,200	—		20	U		19	U		20	U		20	U		20	U		60	U		20	U		59	U	
Phenols																											
Phenol	420	—		35			36			36			40			67			60	U		49			59	U	
2-Methylphenol	63	—		20	U		19	U		20	U		20	U		20	U		60	U		20	U		59	U	
4-Methylphenol	670	—		22			16	J		15	J		28			31			77			30			43	J	
2,4-Dimethylphenol	29	—		20	U		19	U		20	U		20	U		20	U		20	U		20	U		20	U	
Pentachlorophenol	400	540		98	U		97	U		98	U		98	U		98	U		300	U		99	U		300	U	

TABLE 4 (from AMEC, 2011)

DMMP CONVENTIONAL AND CONTAMINANT CHEMISTRY RESULTS[1]

DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

			Sample ID	MC-1			MC-2			MC-3			MC-4			MC-5			MC-6			MC-7			MC-8		
			DMMU	DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 5			DMMU 6			DMMU 7			DMMU 8		
			Sample Type	Composite			Composite			Composite			Composite			Composite			Composite			Composite			Composite		
	DMMP		Date	08/16/2010			08/17/2010			08/18/2010			08/17/2010			08/19/2010			08/20/2010			08/18/2010			08/20/2010		
Parameter	**SL**	**BT**		**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**
Miscellaneous Extractables																											
Benzyl Alcohol	57	—		20	U		19	U		20	U		20	U		20	U		20	U		20	U		20	U	
Benzoic Acid	650	—		200	U		190	U		200	U	UJ	200	U		200	U		600	U	UJ	200	U		590	U	
Hexachloroethane	1,400	—		20	U		19	U		20	U		20	U		20	U		60	U		20	U		59	U	
Hexachlorobutadiene	29	—		0.98	U		0.96	U		0.97	U		1	U		0.98	U		0.99	U		0.98	U		0.98	U	
N-Nitrosodiphenylamine	28	—		20	U		19	U		20	U		20	U		20	U		20	U		20	U		20	U	
Dibenzofuran	540	—		20	U		19	U		20	U		20	U		20	U		60	U		12	J		59	U	
Volatile Organics																											
Trichloroethene	160	—		1.2	U		1.2	U		1.2	U		1.2	U		1.3	U		1.4	U		1.5	U		1.4	U	
Tetrachloroethene	57	—		1.2	U		1.2	U		1.2	U		1.2	U		1.3	U		1.4	U		1.5	U		1.4	U	
Ethylbenzene	10	—		1.2	U		1.2	U		1.2	U		1.2	U		1.3	U		1.4	U		1.5	U		1.4	U	
Total Xylene	40	—		1.2	U		1.2	U		1.2	U		1.2	U		1.3	U		1.4	U		1.5	U		1.4	U	
Pesticides																											
Total DDT	7	50		2	U		1.9	U		2	U		2	U		2	U		2	U		2	U		2	U	
Aldrin	10	—		0.98	U		0.96	U		0.97	U		1	U		0.98	U		0.99	U		0.98	U		0.98	U	
Total Chlordane	10	37		2	U		1.9	U		2	U		2	U		2	U		2	U		2	U		2	U	
Dieldrin	10	—		2	U		1.9	U		2	U		2	U		2	U		2	U		2	U		2	U	
Heptachlor	10	—		3.5	Y	UY	1.5	Y	UY	0.97	U		1	U		0.98	U		0.99	U		0.98	U		0.98	U	
gamma-BHC (Lindane)	10	—		0.98	U		0.96	U		0.97	U		1	U		0.98	U		0.99	U		0.98	U		0.98	U	
Total PCBs	130	38 [3]		19	U		25			19	U		20	U		20	U		20	U		20	U		20	U	

Notes(s)

1. Data qualifiers are as follows.
   - B = Blank contamination.
   - J = Estimated value.
   - R = The sample result is rejected. The presence or absence of the analyte cannot be verified and data are not usable for decision-making.
   - U = Undetected at the reporting limit.
   - UJ = Material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
   - UY = The analyte is not detected at or above the reported concentration. Equivalent to the U flag with a raised reporting limit.
   - Y = The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference.
2. Results from EPA Method 8260C
3. BT value for PCBs expressed as parts per million organic carbon.

Abbreviation(s)

BT = bioaccumulation trigger
DMMP = Dredged Material Management Program
DMMU = Dredged Material Management Unit
EPA = Environmmental Protection Agency
HPAH = high-molecular-weight polycyclic aromatic hydrocarbon
LPAH = low-molecular-weight polycyclic aromatic hydrocarbon
mg/kg = milligrams per kilogram
mg/kg dry wt = milligrams per kilogram dry weight
mg-N/kg = milligrams Nitrogen per kilogram
PCBs = polychlorinated biphenyls
LQ = laboratory assigned qualifier
VQ = qualifier assigned during data validation
SL = screening level
µg/kg dry wt = micrograms per kilogram
µg/L = micrograms per liter
µm = micrometers

TABLE 5 (from AMEC, 2011)

DIOXIN/FURAN CHEMISTRY RESULTS[1]

DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

	Sample ID		MC-1			MC-2			MC-3			MC-4			DMMU 4Z			MC-5			DMMU 5Z		
	DMMU		DMMU 1			DMMU 2			DMMU 3			DMMU 4			DMMU 4			DMMU 5			DMMU 5		
	Sample Type		Composite			Composite			Composite			Composite			Composite			Composite			Composite		
	Date		08/16/2010			08/17/2010			08/18/2010			08/17/2010			08/17/2010			08/19/2010			08/19/2010		
Parameter	**TEF[2]**		**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**
Dioxins (pg/g or parts per trillion)																							
2,3,7,8-TCDD	1		0.219	J		0.459	J		0.372	J		0.37	JY	U	0.0492	U		0.518	J		0.25	J	
1,2,3,7,8-PeCDD	1		0.761	J		1.29	J		1.09	J		1.75	J	J	0.075	KJ	U	1.52	J		0.344	KJ	U
1,2,3,4,7,8-HxCDD	0.1		1.29	J		2.26	J		1.84	J		2.22	J		0.134	KJ	U	2.59	J		0.475	J	
1,2,3,6,7,8-HxCDD	0.1		5.7			9.26			6.53			7.52			0.37	KJ	U	9.2			1.39	J	
1,2,3,7,8,9-HxCDD	0.1		3.34	J		5.64			4.82	J		4.66	J		0.269	J		6.92			1.04	J	
1,2,3,4,6,7,8-HpCDD	0.01		92.3			172			135			158	B	J	6.52			150			26.9		
OCDD	0.0003		857			1600			1130			1140		J	56.4			1230			216		
Furans (pg/g or parts per trillion)																							
2,3,7,8-TCDF	0.1		1.57			2.38			2			2.79			0.083	J		3.44			1.2		
1,2,3,7,8-PeCDF	0.03		0.406	J		0.672	J		0.707	J		0.839	J		0.0535	U		0.962	J		0.326	J	
2,3,4,7,8-PeCDF	0.3		0.583	J		0.817	KJ	U	0.895	J		1.01	JY	U	0.096	KJ	U	1.38	J		0.456	J	
1,2,3,4,7,8-HxCDF	0.1		0.966	J		1.35	J		1.33	J		1.57	J		0.0815	U		2.1	J		0.6	J	
1,2,3,6,7,8-HxCDF	0.1		0.645	J		1.02	J		0.927	J		1.51	J		0.0815	U		1.41	J		0.4	J	
2,3,4,6,7,8-HxCDF	0.1		0.059	J		0.14	KJ	U	0.142	KJ	U	2.23	J		0.0815	U		0.167	J		0.051	J	
1,2,3,7,8,9-HxCDF	0.1		0.633	J		1.03	J		0.97	J		0.65	J		0.0815	U		1.29	J		0.384	J	
1,2,3,4,6,7,8-HpCDF	0.01		12.1			22			16.2			23.8		J	0.805	KJ	U	25.3			11.3		
1,2,3,4,7,8,9-HpCDF	0.01		0.657	J		1.41	J		1.09	J		1.18	JY	U	0.079	KJ	U	1.71	J		0.529	J	
OCDF	0.0003		25.2			71.8			39.6			47.2			1.74	J		54.7			30.2		
TEQ (Total calculated)																							
TEQ (ND=1/2RL)	—		3.90			6.65			5.34			6.61			0.24			7.35			1.58		
TEQ (ND=0)	—		3.90			6.52			5.33			6.26			0.12			7.35			1.41		
Homolog Totals																							
Total TCDD	—		18			35.8			20.9			29.4	BY		2			51.3			17.9		
Total PeCDD	—		13.3			22.4			18.6			29.9			0.232			51			10.5		
Total HxCDD	—		56.3			87.2			72.1			82.3			1.58			109			20.7		
Total HpCDD	—		320			428			387			425	B		17.7			425			62.6		
Total TCDF	—		21.1			26.7			24.5			34.5	Y		0.336			46.2			17.9		
Total PeCDF	—		11.9			14.4			15.8			37.9	XY	J	0.36			25.5			11.2		
Total HxCDF	—		21.2			34.8			24.8			41.4	Y		0.795			38.2			13		
Total HpCDF	—		37.9			77.1			49.7			67.8	Y		1.35			78.9			34		

TABLE 5

DIOXIN/FURAN CHEMISTRY RESULTS[1]

DMMP Full Characterization for Maintenance Dredging
at the Port of Everett Marina
Everett, Washington

	Sample ID		MC-6			DMMU 6Z			MC-7			DMMU 7Z			MC-8			MBR-23Z		
	DMMU		DMMU 6			DMMU 6			DMMU 7			DMMU 7			DMMU 8			DMMU 8		
	Sample Type		Composite			Composite			Composite			Composite			Composite			Individual		
	Date		08/20/2010			08/20/2010			08/18/2010			08/18/2010			08/20/2010			08/20/2010		
Parameter	**TEF[2]**		**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**	**Value**	**LQ**	**VQ**
Dioxins (pg/g or parts per trillion)																				
2,3,7,8-TCDD	1		0.627	JY	U	1.45			0.81	J		0.285	J		0.493	J		0.341	J	
1,2,3,7,8-PeCDD	1		2.32	J	J	2.82	J		4.5	J	J	0.638	J		2.29	J		0.753	J	
1,2,3,4,7,8-HxCDD	0.1		2.93	J		4.25	J		6.59			1.05	J		4.3	J		1.22	J	
1,2,3,6,7,8-HxCDD	0.1		11.6			19.4			27			3.81	J		16.8			3.61	J	
1,2,3,7,8,9-HxCDD	0.1		6.42			11			14.9			2.75	J		11.1			2.8	J	
1,2,3,4,6,7,8-HpCDD	0.01		224	B	J	352			490	B	J	70.8			291			53.2		
OCDD	0.0003		1700		J	2910			3900		J	675			2530			528		
Furans (pg/g or parts per trillion)																				
2,3,7,8-TCDF	0.1		7.77			17.4			5.79			2.11			3.11			2.72		
1,2,3,7,8-PeCDF	0.03		1.27	J		2.05	J		1.72	J		0.466	J		1.01	J		0.722	J	
2,3,4,7,8-PeCDF	0.3		1.47	J		2.88	J		2.16	J		0.636	J		1.17	J		0.838	KJ	U
1,2,3,4,7,8-HxCDF	0.1		2.36	J		5.56			4.04	J		0.933	J		2.49	J		1.09	KJ	U
1,2,3,6,7,8-HxCDF	0.1		1.62	J		3.49	J		2.98	J		0.598	J		1.66	J		0.771	J	
2,3,4,6,7,8-HxCDF	0.1		0.0491	U		0.35	J		4.61	J		0.075	J		0.142	J		0.153	J	
1,2,3,7,8,9-HxCDF	0.1		0.802	J		2.95	J		1.45	J		0.546	J		1.74	J		0.62	J	
1,2,3,4,6,7,8-HpCDF	0.01		38.5		J	100			56		J	18.8			40.5			16.5		
1,2,3,4,7,8,9-HpCDF	0.01		2.27	J		5.82			3.31	J		0.952	J		2.24	J		0.961	J	
OCDF	0.0003		86.4			264			111			48.4			85			41.4		
TEQ (Total calculated)																				
TEQ (ND=1/2RL)	—		9.65			17.2			19.4			3.44			11.4			3.36		
TEQ (ND=0)	—		9.34			17.2			19.4			3.44			11.4			3.18		
Homolog Totals																				
Total TCDD	—		65.4	BY		77.5			99.8	BY		36.1			54.7			52.8		
Total PeCDD	—		61.2			62.3			111			20.7			48.1			39.4		
Total HxCDD	—		140			193			280			48.1			169			65.5		
Total HpCDD	—		606	B		873			1320	B		179			844			140		
Total TCDF	—		45	Y		109			46.1	XY	J	27.1			34.3			37		
Total PeCDF	—		29.4	XY	J	63.4			46.4	XY	J	11			23			13.5		
Total HxCDF	—		53.3	Y		130			98.7	XY	J	20			62.2			20.5		
Total HpCDF	—		124			347			171			62.4			129			56.3		

Notes(s)

1. Data qualifiers are as follows.
   - B = Blank contamination.
   - J = Estimated value, concentration less than reporting limit.
   - KJ = Peak detected but did not meet quantification criteria. Result reported represents the estimated maximum possible concentration.
   - JY = Estimated Maximum Possible Concentration (EMPC), concentration less than reporting limit.
   - BY = Blank contamination, Estimated Maximum Possible Concentration (EMPC).
   - XY = Estimated Maximum Possible Concentration (EMPC). Polychlorinated diphenyl ether interference.
   - X = Polychlorinated diphenyl ether interference.
   - U = Undetected at the reporting limit.
   - Y = Estimated Maximum Possible Concentration (EMPC).
2. 2005 World Health Organization (WHO) (Van den Berg et al. 2006).

Abbreviation(s)

DMMP = Dredged Material Management Program
DMMU = Dredged Material Management Unit
ND = nondetect
pg/g = picograms per gram
LQ = laboratory assigned qualifier
VQ = qualifier assigned during data validation
RL= reporting limit
TEF = toxicity equivalency factors
TEQ = toxicity equivalency quotient